

ELEVATED FIRE DANGER CONDITIONS ASSOCIATED WITH FOEHN-LIKE WINDS IN EASTERN VICTORIA

J.J Sharples, R.O Weber

School of Physical, Environmental and Mathematical Sciences, University of New South Wales at the Australian Defence Force Academy

R.H.D McRae

A.C.T Emergency Services Agency

G.A Mills

Bureau of Meteorology Research Centre

Background

Foehn winds are strong, dry and warm winds that result from the effects that mountains have on the atmosphere. Air that is forced to rise over a mountain barrier can become drier and warmer through orographic precipitation and latent heat release during condensation. Further warming can take place due to compression as the air descends in the lee of the mountain barrier. Alternatively, when lower level air is blocked by a mountain barrier, drier air from above can flow down the lee side of the mountain barrier where it gains strength and is warmed by adiabatic compression.

Consequently, foehn winds can lead to elevated fire danger conditions. The Santa Ana winds of Southern California are an example of foehn winds that are associated with severe fires (e.g. the Cedar Fire, 2003). The extent to which foehn-like conditions affect fire danger in Australia is an open problem.

29th May 2007: A Case Study

Conditions resembling a foehn occurrence were observed in eastern Victoria on the 29th of May 2007. Characteristics of this event were:

- Elevated temperature, lower relative humidity (figure 1a) and increased wind speed downwind from the mountains
- Subsequent increase in the fire danger index downwind of the mountains (figure 1b)

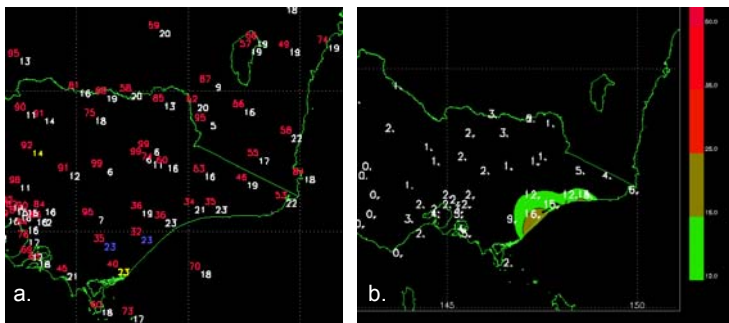


Figure 1. Bureau of Meteorology data for 15:00 AEST 29th of May 2007. Panel (a) shows temperature and relative humidity (in red) with a region of low relative humidity and elevated temperature southeast of the ranges while panel (b) shows the corresponding region of elevated FFDI.

To understand the characteristics of this type of event and the implications for fire management, the Bureau of Meteorology's 5km MesoLAPS numerical weather model was used to analyse the atmospheric behaviour during the event. Figure 2 shows a vertical profile of atmospheric features which suggest that upper air is replacing lower air on the lee side of the ranges. There is also evidence of a lee wave being present.

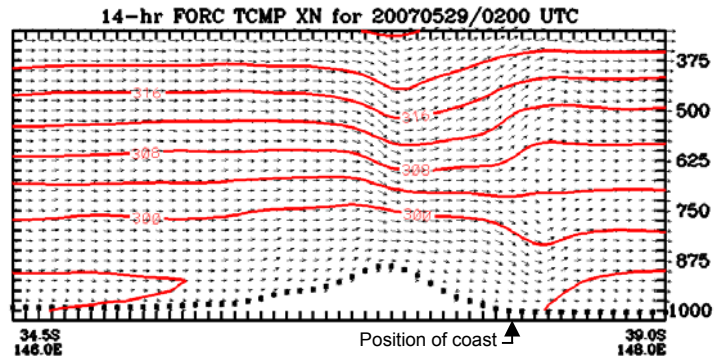


Figure 2. Vertical cross section of MesoLAPS model output showing the projected wind vector and potential temperature (contours) for 12:00 AEST 29th May 2007.

Figure 3a illustrates the link between the 500mb spatial pattern of the omega (ω) field and the topography. The ω pattern is consistent with a downslope wind in the lee of the ranges. Figure 3b illustrates the link between modelled mixing ratio and observed atmospheric moisture at 500mb. The water vapour imagery shows persistent patterns during the event that are consistent with a foehn gap (dry area in the lee of the ranges) and foehn arch (the whitish region over the southeast coast). Figure 3b suggests that there is a reasonable correlation between these features and the model predictions.

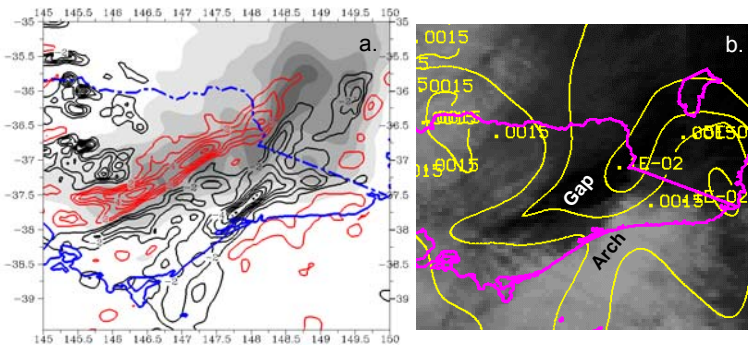


Figure 3. (a) MesoLAPS model output of 500mb ω -field for 12:00 AEST 29th May 2007 showing relationship with the topography. Positive regions (red) indicate descending air, negative regions (black) indicate ascending air. (b) MesoLAPS model output of 500mb mixing ratio field showing the relationship of the field structure with features in water vapour imagery.

Conclusions

The analyses suggest that the elevated fire conditions on the 29th of May 2007 were due to a foehn-like event caused by blocking of lower level air to the northwest of the ranges. Further work on these foehn-like occurrences will enhance understanding of fire weather and assessments of bushfire risk in regions prone to these conditions.